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Bat Community Composition and Monitoring for White-Nose Syndrome at First State National Historical Park, Delaware and Pennsylvania

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Natural Resource Stewardship and Science

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Natural Resource Report NPS/FRST/NRR—2017/1482

ON THE COVER
Big brown bat captured at First State National Historical Park
Photograph by: Juliet Nagel

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Abstract

In recent years, bats have faced increasingly deadly threats on multiple fronts. Cave-dwelling bats have been decimated by the emergence of a disease, white-nose syndrome (WNS), caused by a fungal pathogen, *Pseudogymnoascus destructans*; and tree bats are dying in large numbers at wind power facilities. First State National Historical Park (FRST) is a new national park unit located in northern Delaware and Pennsylvania. Prior to this study, little information was available on bat species and their activity and distribution within FRST. To fill this knowledge gap, we conducted an inventory of bat species present at FRST. We used mist-nets to capture bats and an ultrasonic acoustic receiver to record echolocation calls. We conducted mist-net surveys for five nights and captured 21 bats, including 6 eastern red bats (*Lasiurus borealis*) and 15 big brown bats (*Eptesicus fuscus*). We conducted acoustic surveys at six sites throughout the park for a total of 131.2 minutes of recordings. From these surveys, we collected 166 bat echolocation passes of which we identified 81% (31 passes were classified as unknown). Of the identifiable calls, 25.9% were eastern red bats, 33.3% were hoary bats (*L. cinereus*), and 40.7% were big brown or silver-haired bats (*Lasionycterus noctivagans*). We did not capture or record any little brown bats (*Myotis lucifugus*), northern long-eared bats (*M. septentrionalis*), tricolored bats (*Perimyotis subflavus*), or eastern small-footed bats (*M. leibii*). The first three myotine species are highly susceptible to WNS, resulting in precipitous population declines elsewhere.

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Introduction

In recent years, bats have increasingly faced deadly threats on multiple fronts. Cave-dwelling bats have been decimated by the emergence of white-nose syndrome (WNS), a disease caused by the psychrophilic fungus *Pseudogymnoascus destructans* (*Pd*) (Zukal et al. 2014). Since the discovery of WNS in New York State in 2006, populations of North America's cave-dwelling bat species have plummeted by millions of individuals (Blehert et al. 2009, Dzal et al. 2010, Brooks 2011). In 2012, it was estimated that the North American bat death toll had exceeded 5.5 million (USFWS 2012). The pathogen, *Pd*, continues to spread westward (Maher et al. 2012). By spring 2016, it had reached eastern Nebraska, eastern Oklahoma, and eastern Minnesota, 1,900 km (1,180 mi) from its apparent site of introduction (Sleeman 2016*a*). Furthermore, a case of WNS was detected in Washington State, about 2,100 km (1,300 mi) from the previous westernmost detection of the fungus in eastern Nebraska (Lorch et al. 2016, Sleeman 2016*b*, white-nose syndrome.org 2017*a*). White-nose syndrome affects some species more than others; especially susceptible are little brown bats (*Myotis lucifugus*), northern long-eared bats (*M. septentrionalis*), and tricolored bats (*Perimyotis subflavus*; Dzal et al. 2010, Brooks 2011, white-nose syndrome.org 2017*b*). At the same time, migratory foliage-roosting bats (i.e., tree bats) are dying in large numbers at wind-power facilities; one estimate placed the number of bats killed at wind-power facilities in the United States in 2012 alone at 600,000 (Hayes 2013). The species most affected by mortalities at wind-power facilities are hoary bats (*Lasiurus cinereus*), eastern red bats (*L. borealis*), and silver-haired bats (*Lasionycteris noctivagans*; Fiedler 2004, Johnson et al. 2003, Johnson 2005, Cryan and Barclay 2009, Grodsky 2010, Cryan 2011).

Scant data are currently available on the status of bat populations on many public lands; such information is critically needed for informed management decisions. One such area is First State National Historical Park (FRST), located at the northern edge of Delaware, extending up into Pennsylvania. It is adjacent to Brandywine Creek State Park, Wilmington, Delaware. This national park unit was originally created as First State National Monument under the Antiquities Act in 2013 and later re-designated as First State National Historical Park in 2015 by the U.S. Congress. Nine bat species potentially occur in Pennsylvania and Delaware, including big brown bats (*Eptesicus fuscus*), silver-haired bats, eastern red bats, hoary bats, evening bats (*Nycticeius humeralis)*, eastern small-footed bats (*M. leibii*), little brown bats, northern long-eared bats, and tricolored bats (Whitaker and Hamilton 1998, Harvey et al. 1999). Although bat mortality at wind turbine facilities is not a major mortality factor in Delaware, WNS has been present since 2010 and in nearby Pennsylvania since 2008 (DNREC 2012, white-nose syndrome.org 2017*a*). To provide much needed information on the status of bat-species populations at FRST, an inventory of the Beaver Valley (Woodlawn tract) was proposed to determine bat species presence/absence, relative activity, distribution, and health.

Objectives

The primary goals of this inventory were to identify the bat species, their relative activity, distribution, and health at First State National Historical Park (FRST), specifically by:

1. Conducting an inventory of bat community composition that covers various potential habitats;
2. Confirming the presence of bat species and their relative activity in specific areas;
3. Determining the health of bat species based on a physical examination; and
4. Ascertaining the presence of any rare, threatened, or endangered (RTE) bat species.

Study Area

Beaver Valley (Woodlawn tract) runs along Brandywine Creek and covers 445 ha (1,100 acres) of woods and pastures, with 356 ha (880 acres) in northern New Castle County, Delaware, and the remaining portion in Delaware County, Pennsylvania (FRST 2017; Figure 1). Potential bat habitats include mature woodlands, springs, brooks, floodplains, and agricultural fields (Jones 2013).

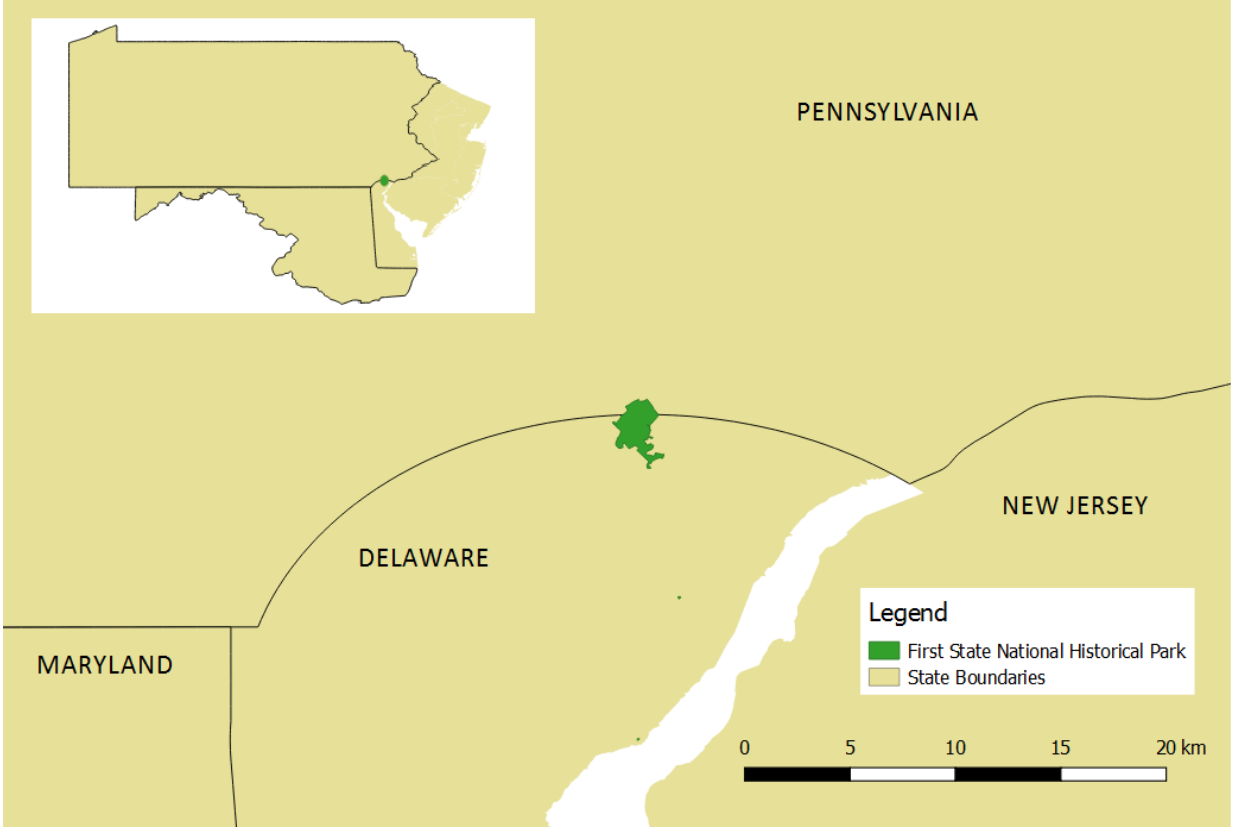

Figure 1. Map of First State National Historical Park in Delaware and Pennsylvania, USA.

Methods

To inventory bats in the park, we used a combination of captures (mist-nets) and passive acoustic recordings (ultrasonic receiver). We chose mist-net and acoustic survey locations that optimized our likelihood of encountering bats, e.g., over streams, near water, and across trails that bats would likely use as travel corridors (Figure 2).

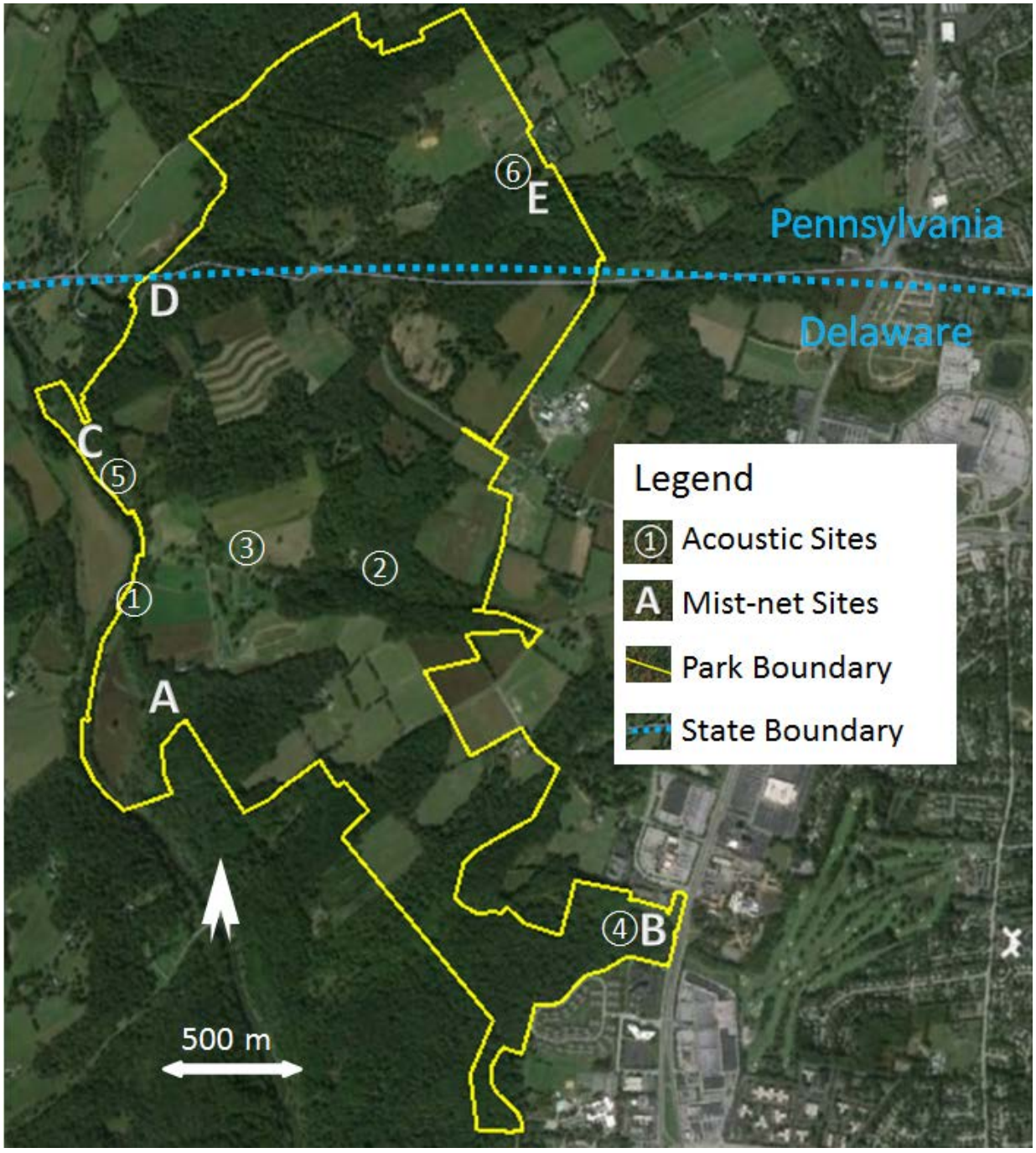

Figure 2. Acoustic and mist-net sites surveyed during July 2015 at First State National Historical Park, Delaware and Pennsylvania, USA (*Image source*: Google 2016; *Image date*: 10/7/2011).

Site descriptions

We erected mist-nets at five locations throughout the park (labeled A through E in Figure 2) (Appendix A). Site A was located along a forested path wide enough for a motor vehicle; two triple-high mist-nets were placed perpendicular to the path and approximately 35 m apart. The eastern side of the path was forested, while the western side consisted of a thin strip of trees with an agricultural field beyond. A closed canopy occurred over the path. Site B was located in the southern portion of the park. One single-high mist net was placed over a shallow pool along a small stream. A second triple-high mist-net was placed 20 m away at the intersection of three hiking trails within the forest. The canopy at this site was completely closed. Site C was over a stream flowing into Brandywine Creek. One triple-high mist-net was placed perpendicular to the stream approximately 60 m from Brandywine Creek. Forest occurred along the north side of the creek, and a mostly open grassy area with scattered trees occurred along the south side. There was no closed canopy at this site. Site D was over a shallow stream running alongside Beaver Dam Road. A single triple-high mist-net was erected perpendicular to the road. It was placed where overhanging trees created a funnel effect. Site E was along hiking trails in the northern portion of the park. Two triple-high mist-nets were placed at this site. The first was perpendicular to a hiking trail where it exited the forest and followed along the edge of an agricultural field. The second was placed approximately 80 m away at a three-way intersection of hiking trails through the forest.

We passively recorded bat acoustic calls at six locations (labeled 1 through 6 in Figure 2) (Appendix B). Site 1 was situated along a wide hiking trail that ran alongside Brandywine Creek. Site 2 was in a forest clearing with a small stream running through it. The clearing was open with no canopy cover and was surrounded by forest. Site 3 was next to an old building surrounded by agricultural fields. Site 4 was in the forest and had a closed canopy. Site 5 was in a wide grassy clearing next to Brandywine Creek. Site 6 was at the edge of a forest and an agricultural field.

Bat captures

To capture bats, we used 38 mm mesh mist nets (Avinet, Dryden, New York, USA) measuring 3.6 m (8.5 ft.) high and 6, 9, or 12 m (19.6, 29.5, or 39.4 ft.) long. We erected mist nets over stream corridors and across trails as bats use these areas for foraging and as travel corridors. At each location, depending on space availability and forest structure, we placed 1 or 2 triple-high mist-nets (3 mist nets stacked vertically and suspended with a rope and pulley system on two 10-m [32.8 ft.] poles [Figure 3]). At one site, we also placed a ground net (i.e., a single mist net stretched between two 3-m [9.8 ft.] poles) across a stream (Figure 4). We conducted mist netting for 4 hours, beginning 30 minutes after sunset, as bat activity peaks within the first few hours each night (Agosta et al. 2005). No trapping was conducted during rain, high wind (≥20 kph [≥12 mph]), or cold temperatures (<9º C [<48º F]).

Figure 3. Photograph of triple-high mist-net set up at a site in western Pennsylvania.

Figure 4. Photograph of single-high mist-net set up at site B, First State National Historical Park.

For each captured bat, we recorded the species, time captured, weight (measured with a Pesola scale to the nearest 0.5 gram [g]), forearm length in millimeters (mm), age (adult or juvenile, based on the fusion of the phalangeal epiphysis [Anthony 1988]), sex, reproductive condition (for males, non-reproductive or testes descended; for females, non-reproductive, pregnant, lactating, or post-lactating), wing score (0–4 where 0 is no damage and 4 is highly damaged [Reichard 2008]), and noted any abnormalities. For all bats captured in Delaware, we attached wing bands marked with DEFW and a unique number (Porzana Ltd., Icklesham, East Sussex, United Kingdom).

We followed standard decontamination protocols recommended by the U.S Fish and Wildlife Service to prevent the spread of WNS (white-nose syndrome.org 2012). We placed bats singly in new paper lunch bags until processing, and we used a new pair of latex gloves for each bat. We disinfected all measuring instruments that came in contact with a bat (rulers and forceps) by submerging in alcohol and followed by flaming. After each trapping night, we disinfected all mist nets with a 0.3% Lysol solution.

Acoustic monitoring

To record bat calls, we used Binary Acoustic's BAT AR125 125 kHz ultrasonic receiver (Binary Acoustic Technology, Tucson, Arizona, USA) attached to a laptop computer. The receiver was positioned approximately 1.5 m (5 ft.) off the ground and aimed toward a stream, path, or clearing where bats were likely to fly. We recorded for 20 minutes at each site. Depending on the species, bats can travel several kilometers between day roosts and feeding sites; flying at many tens of kilometers per hour, they can easily cover these distances in 20 minutes (Whitaker 1980, Nowak 1994). Therefore, a 20-minute timeframe allowed us to assume that any bat that used a given site had the potential to be present within that timeframe.

To view and identify bat passes, we used CallViewer18 (Skowronski and Fenton 2008). Using minimum frequency, maximum frequency, call duration, and call shape, we manually identified each pass to one of the following categories: unknown, hoary bat (Figure 5), eastern red bat (Figure 6), or big brown/silver-haired bat (Figure 7). We did not attempt to separate big brown and silver-haired bats as their calls are very similar and have overlapping characteristics (Betts 1998). We classified bat calls as "unknown" when they were too weak to make accurate measurements, included unusual or potential social calls that influenced call characteristics, or contained fewer than 3 calls in the pass.

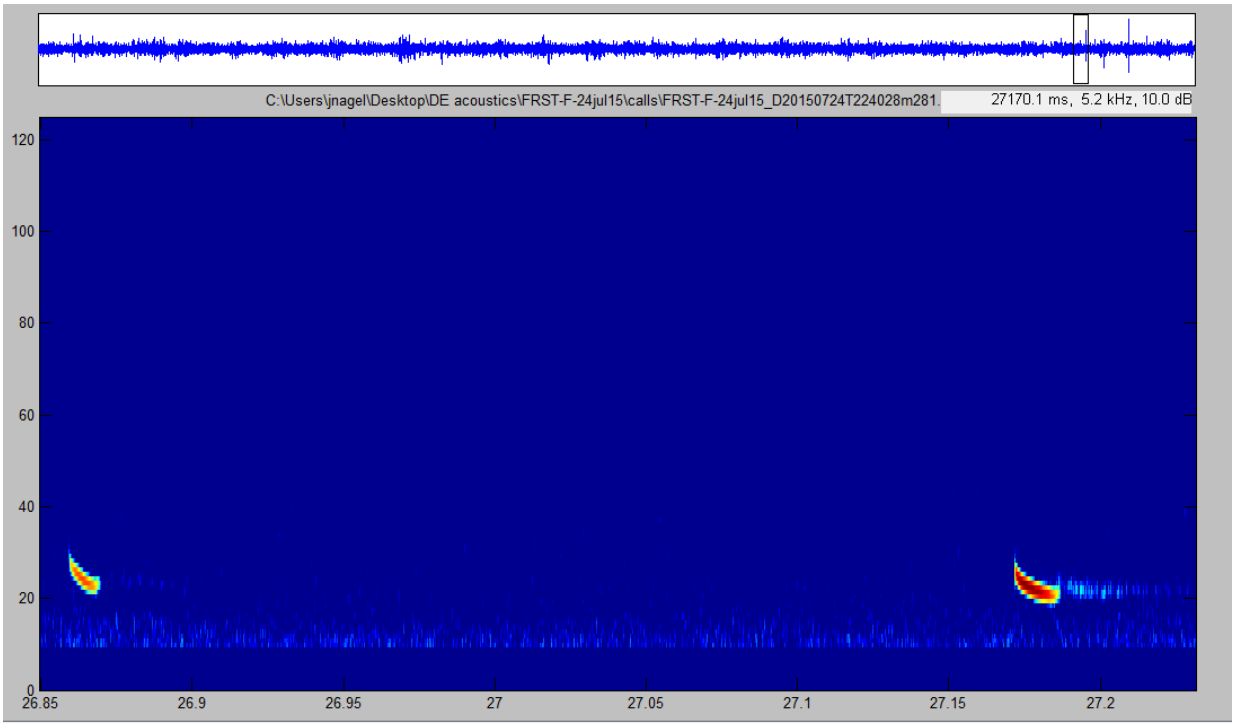

Figure 5. Spectrogram of hoary bat echolocation calls recorded at First State National Historical Park, 24 July 2015. The X-axis is time in seconds, and the Y-axis is frequency in kilohertz.

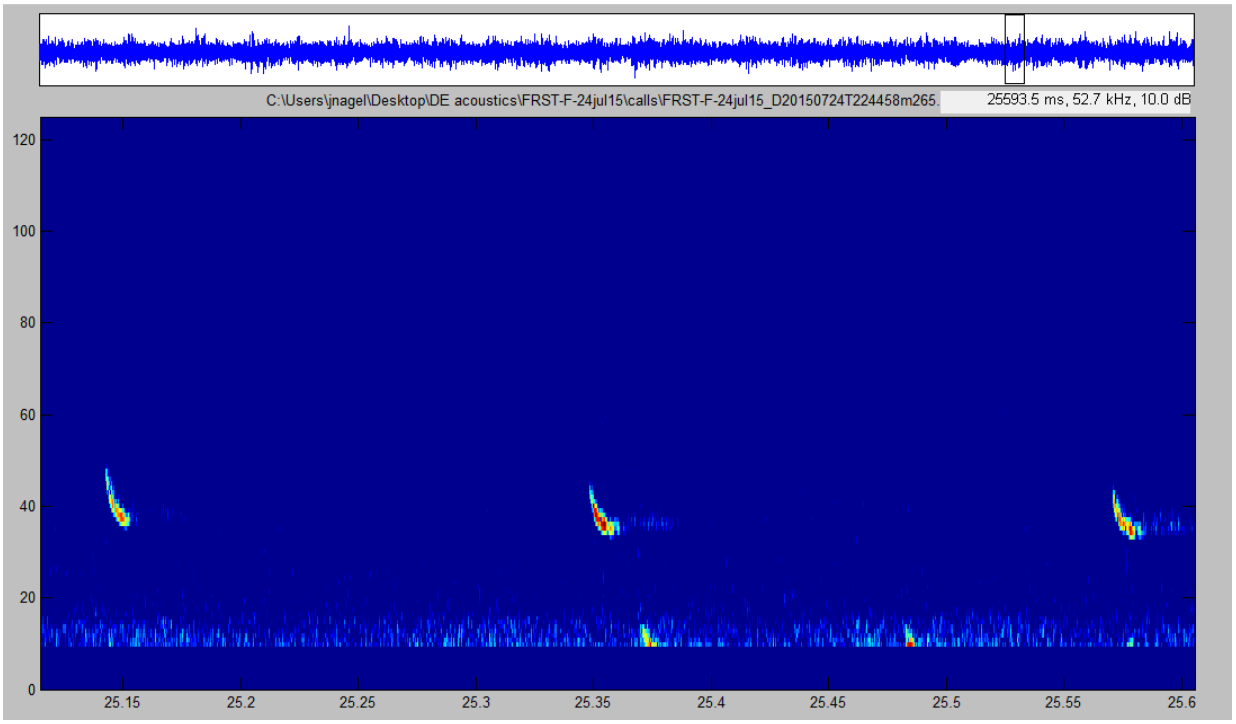

Figure 6. Spectrogram of eastern red bat echolocation calls recorded at First State National Historical Park, 24 July 2015. The X-axis is time in seconds, and the Y-axis is frequency in kilohertz.

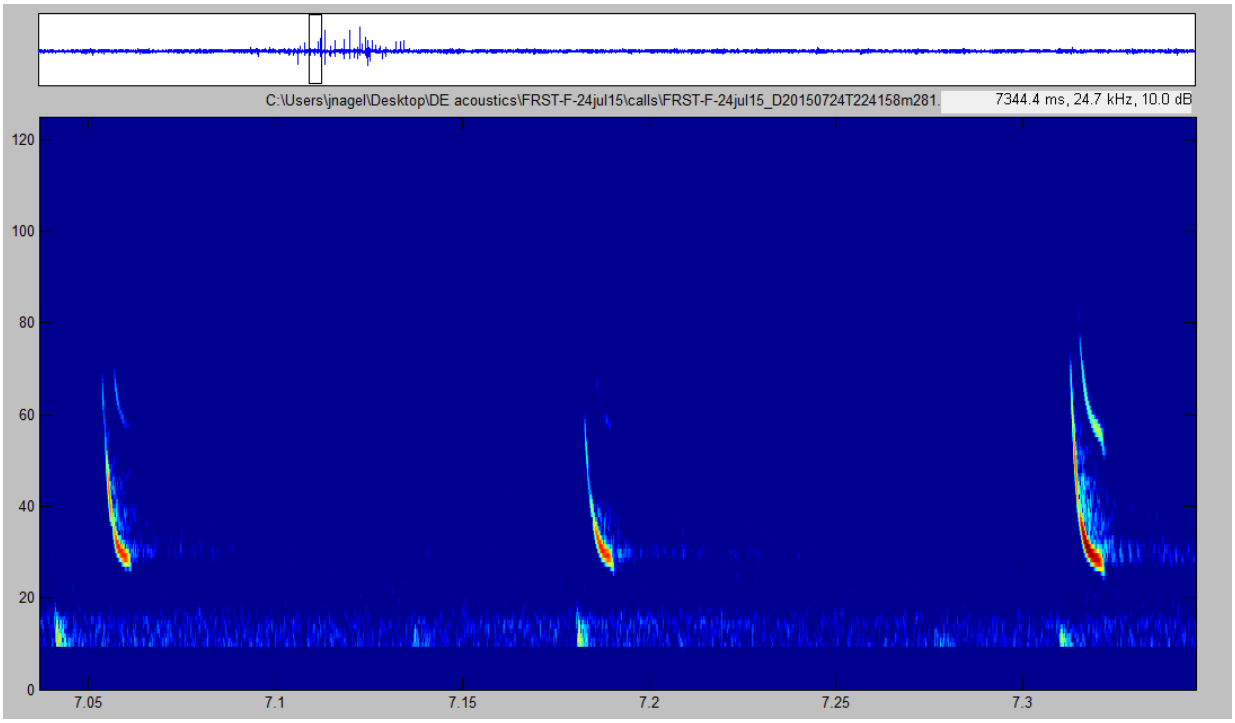

Figure 7. Spectrogram of big brown bat or silver-haired bat echolocation calls recorded at First State National Historical Park, 24 July 2015. Call characteristics overlap for these two species, so we did not separate them. The X-axis is time in seconds, and the Y-axis is frequency in kilohertz.

Results

Bat captures

Between 21 and 24 July 2015, we deployed mist nets at five sites located throughout FRST and captured 21 bats (Appendix C), including 15 big brown bats (Figure 8) and 6 eastern red bats (Figure 9).Of the 6 eastern red bats captured, 1 was male, 3 were female, and 2 escaped from the mist net before we could determine sex. Of the big brown bats, 12 were male and 3 were female (Table 1). The majority of the bats (14 of the 21 individuals; 67%) were captured at site E, a forested hiking trail in the northern portion of the park. With one exception, all the bats had a wing score of zero, indicating healthy wings with no sign of scarring from WNS. The exception was a post-lactating female big brown bat captured at site E, with a wing score of 1.

Figure 8. Photo voucher of big brown bat captured at First State National Historical Park on 21 July 2015.

Figure 9. Photo voucher of eastern red bat captured at First State National Historical Park on 22 July 2015.

Table 1. The total number of bats captured at each site in 2015.

		Eastern Red Bat			Big Brown Bat			
Site	**Date**	**M**	**F**	**Unknown**	**M**	**F**	**Total**	**Site description**
A	21 July	0	1	1	2	1	5	Wide trail through forest
B	22 July	0	1	0	0	0	1	Narrow trail and stream in forest
C	23 July	0	0	0	0	0	0	Over stream near Brandywine Creek
D	23 July	1	0	0	0	0	1	Over stream running along a road
E	24 July	0	1	1	10	2	14	Hiking trail through forest
Total		1	3	2	12	3	21	

Notes: M = male, F = female. Unknown refers to two individual bats that escaped from the net following capture. Each site was trapped for four hours.

Species captures

Big brown bats

We captured big brown bats at two of the five mist net sites (A and E), both of which were over trails through a forest. We recorded big brown or silver-haired bats (we did not attempt to distinguish the two due to overlapping call characteristics) at all six acoustic sites (Figure 10).

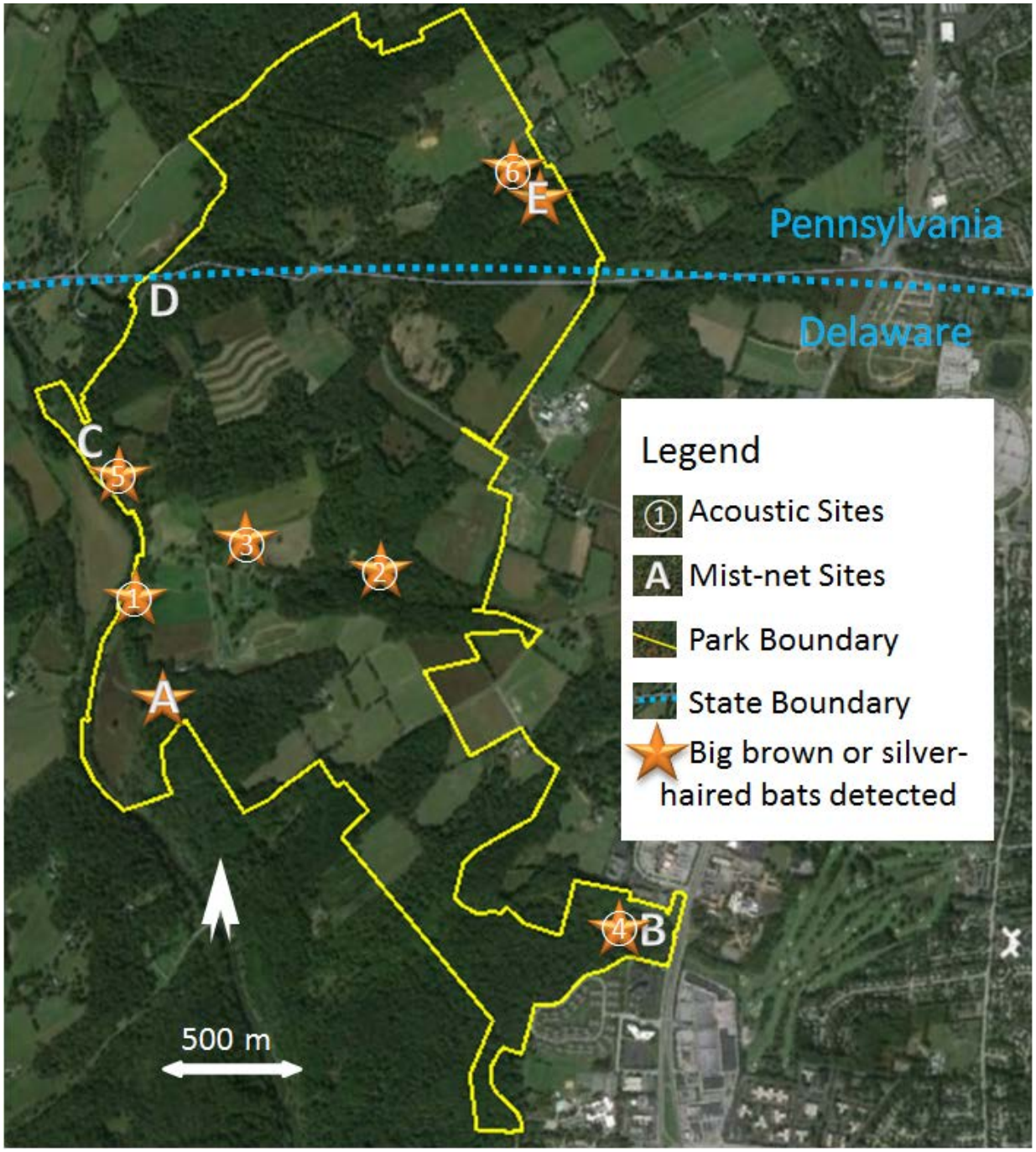

Figure 10. Mist-net sites where big brown bats were captured, and acoustic sites where big brown bats or silver-haired bats were recorded, in July 2015 (*Image source*: Google 2016; *Image date*: 10/7/2011).

Eastern red bats

We captured eastern red bats at four of the five mist net sites, including over trails and streams. We also recorded eastern red bat echolocation calls at four of the six acoustic sites (Figure 11).

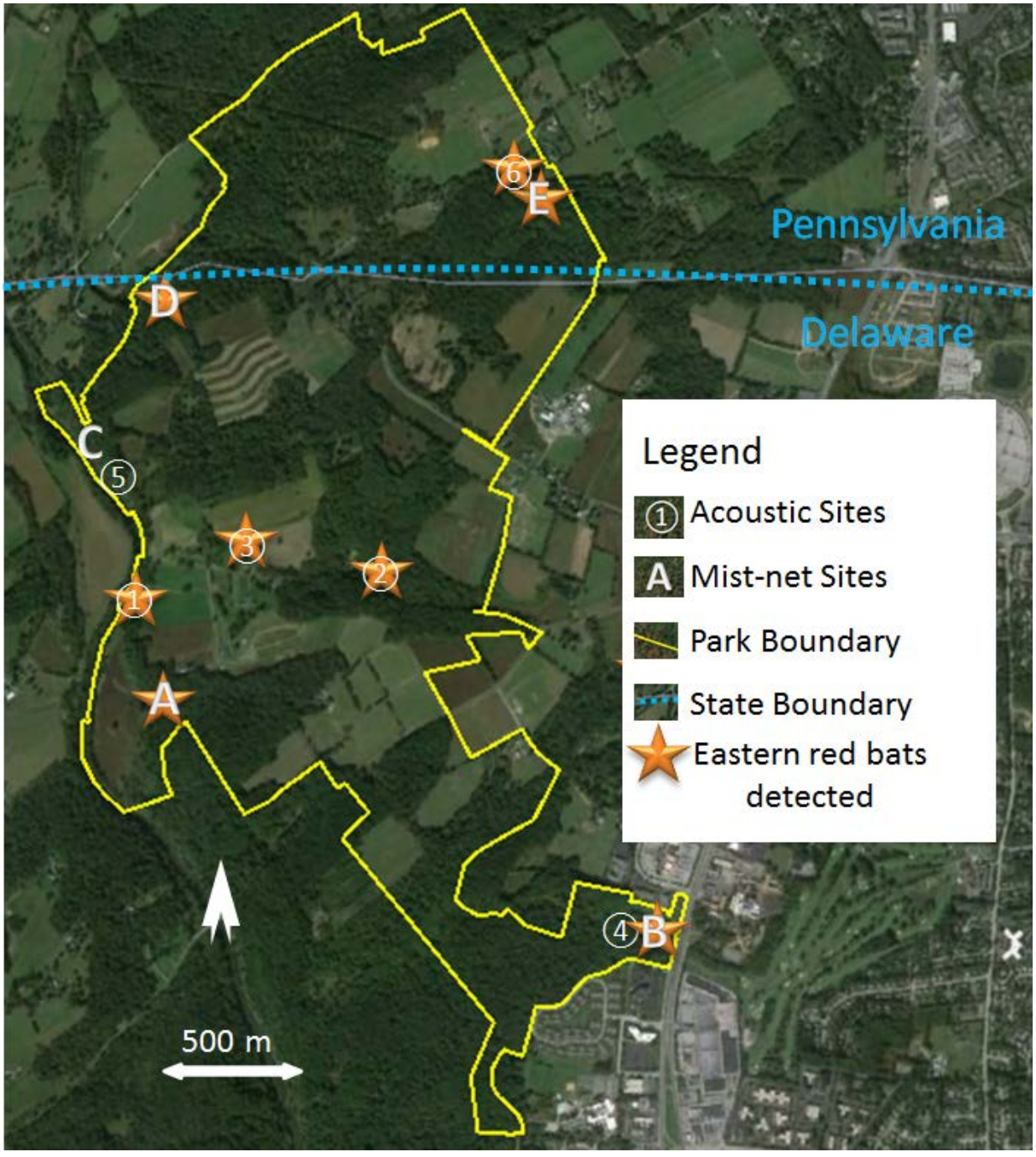

Figure 11. Mist-net sites where eastern red bats were captured, and acoustic sites where eastern red bats were recorded, in July 2015 (*Image source*: Google 2016; *Image date*: 10/7/2011).

Hoary bats

We did not capture any hoary bats, though we recorded their echolocation calls at five of the six acoustic survey sites (Figure 12).

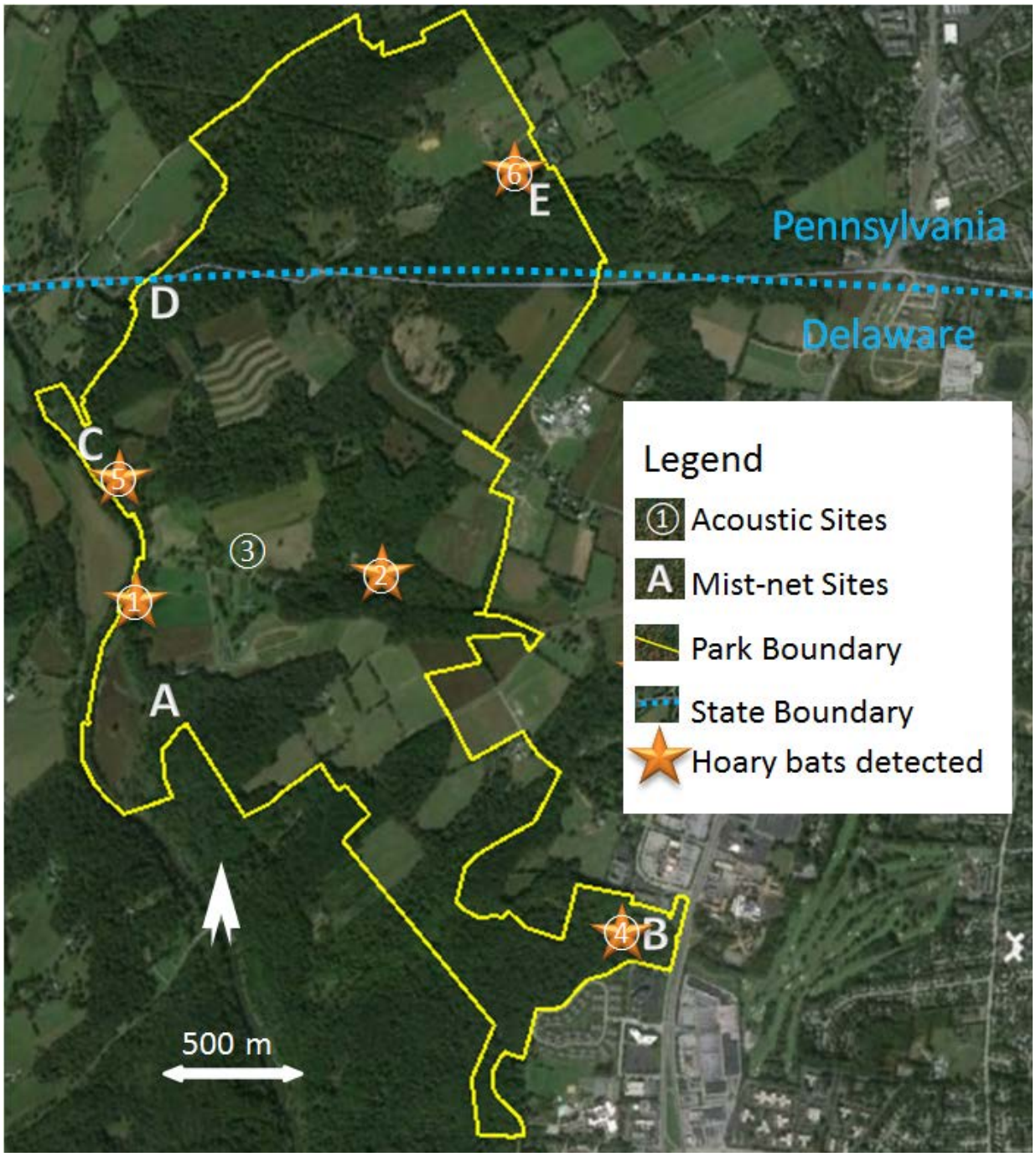

Figure 12. Acoustic sites where hoary bats were recorded in July 2015 (*Image source*: Google 2016; *Image date*: 10/7/2011).

Acoustic monitoring

Between 21 and 24 July 2015, we surveyed six acoustic sites located throughout the park, each for approximately 20 minutes, for a total of 131.2 minutes of acoustic recordings. This effort resulted in 166 bat echolocation passes, of which we identified 81% (31 were classified as unknown) (Table 2). Of the identifiable calls, 25.9% were eastern red bats, 33.3% were hoary bats, and 40.7% were big brown or silver-haired bats.

Table 2. Total number of bat passes recorded at First State National Historical Park in 2015.

Site	Survey length (minutes)	Big brown or Silver-haired bat	Hoary bat	Eastern red bat	Unknown	Total	Passes per minute
1	23.5	8	6	3	8	25	1.065
2	19.6	9	4	2	4	19	0.972
3	20.4	2	0	11	5	18	0.882
4	21.0	1	1	0	3	5	0.238
5	25.4	28	27	0	9	64	2.521
6	21.3	7	7	19	2	35	1.641
Total	131.2	55	45	35	31	166	Avg. = 1.265

Disposition of data

Hardcopies of data forms are currently being archived at the University of Maryland Center for Environmental Science, Appalachian Laboratory, Frostburg, Maryland 21532. These will be scanned and converted to portable document format (pdf) for storage. Acoustic data files, digital photography, and Excel spreadsheets are stored on computer systems of the Appalachian Laboratory that are backed up to several on and off campus storage devices. Copies of all raw data (data sheets, acoustic files, GIS layers, digital photographs, and any other spreadsheets or files) will be provided to the FRST to archive.

Discussion and Conclusions

By combining mist-net surveys with acoustic monitoring, we obtained a more complete assessment of the current status of bats at FRST. We can affirm that during this study: 1) no rare, threatened, or endangered (RTE) species were captured or detected at FRST; 2) small, cave-dwelling bat species (little brown bats, tricolored bats, and northern long-eared bats) were not captured or detected; and 3) big brown, red, and hoary bats occurred throughout FRST and were the predominant bats on the landscape. Since no data were available on bat species at FRST prior to the appearance of WNS in Pennsylvania or Delaware, we cannot evaluate its impact on bat populations in the park.

The predominate bats captured during this study (big brown, red, and hoary bats) are species currently considered common throughout their range. Although big brown bats can be infected by WNS, they appear to be less susceptible to infection and have not incurred the same declines as myotine bats, possibly due to their roosting habits and relatively large body size (Frank et al. 2014). Though we did not differentiate big brown and silver-haired bat acoustic calls, the large number of big brown bat mist-net captures suggested that big brown bats made up the majority of calls in the big brown and silver-haired bat group. Hoary bats and eastern red bats, which are both tree-bat species, do not use caves to hibernate and therefore have not been affected by the Pd fungus. We captured and recorded eastern red bats throughout FRST and acoustically detected hoary bats. Our low capture success of hoary bats was likely due to their tendency to fly above the canopy and therefore avoid mist-net capture (Menzel et al. 2005).

Species susceptible to WNS include most myotine species, as well as tricolored bats (white-nose syndrome.org 2017b). We did not capture or record any little brown bats, northern long-eared bats, or tricolored bats at FRST; these once common species have nearly disappeared across much of their former range in the northeastern United States. For example, numbers of northern long-eared bats (from hibernacula counts) have declined by up to 99% (USFWS 2015a). As a consequence, in 2014 the little brown bat and the northern long-eared bat were listed as endangered in Delaware (Delaware.gov 2016). Furthermore, the northern long-eared bat was also federally-listed in 2015 as threatened under the Endangered Species Act (USFWS 2015b).

When interpreting the results of this survey, it is important to consider its limitations. Although capturing bats in mist nets can provide data on species presence/absence, relative abundance, sex ratio, reproductive condition, and health, several factors can affect capture success and introduce biases into the results. These include mist net placement, the ability of some species to avoid capture, and environmental conditions at the time of netting (Carroll et al. 2002, MacCarthy et al. 2006, Geluso and Geluso 2012). Furthermore, only certain areas can be successfully sampled with mist-nets (e.g., flyways with sufficient canopy cover, small ponds, and streams). Stationary acoustic monitoring also has its limitations, especially related to manual call identification and statistical inference. For example, acoustically monitoring bats via stationary points allows the estimation of species presence/absence and activity levels, but does not permit estimation of species abundance due to the possibility of one individual being recorded multiple times. Furthermore, identification of certain species from acoustic data involves some amount of error due to call quality and, if done

manually, is highly dependent on the skill of the investigator. Combining bat calls that are similar into groups, e.g., big brown/silver-haired bat group, may reduce misclassifications; however, important information on bat-species behavior or ecology are lost. Despite its limitations, bat acoustic surveys remain a valuable means for estimating species presence/absence and activity across a greater area than labor-intensive mist netting and for species that are difficult to capture in mist nets or harp traps (e.g., hoary bats).

Our survey was also limited to a certain number of days and the fact that only one area could be surveyed per night; therefore, we emphasize that our lack of captures of certain bat species does not indicate that the species is not present within the park. Though our survey sites were distributed in areas that we felt maximized capture success, several species whose populations have been decimated by WNS or that are naturally rare may have been detected with the addition of more areas monitored over a longer time period. Short-term surveys frequently do not satisfy sampling protocols established for RTE species. For example, the U.S. Fish and Wildlife Service protocol for presence/absence surveys for Indiana (*M. sodalis*) or northern-long eared bats consist of a minimum of 42 net nights (5 hr/night) or a minimum of 4 detector nights (sunset to sunrise) per 50 ha (123 acres or 0.5 km2) of suitable summer habitat (USFWS 2017). Assuming all 445 ha (1,100 acres) of FRST were suitable summer habitat, that level of effort would entail 376 net nights or 36 detector nights. Lastly, because we did not conduct surveys during the migration period our study may have been biased toward captures of resident species rather than migrants, such as eastern red, hoary, and silver-haired bats.

Recommendations

Rare, threatened, or endangered species are intrinsically difficult to detect due to their low numbers; however, understanding species presence, abundance, distribution, and other factors is critical for effective management (Hoyt et al. 2016). If feasible, we recommend that FRST consider instituting an annual monitoring program using acoustic bat detectors. Protocols for such programs can be found in the North American Bat Monitoring Program (NABat) and the Range-wide Indiana Bat Summer Survey Guidelines (Loeb et al. 2015, USFWS 2017, USGS 2017). Acoustic surveys are less time intensive and do not require personnel trained in bat capture techniques, such as identification, handling, taking measurements, and WNS decontamination protocols. Furthermore, personnel would not need the often expensive pre-exposure rabies vaccinations required of bat handlers. If acoustic surveys were conducted, FRST would have to invest in one or more bat detectors and software for identification of bat calls (e.g., SonoBat 4 or Kaleidoscope Pro 4 Analysis Software). With one detector and sampling a stationary point over four nights, potentially eight points could be sampled over eight, five-day work weeks (June-July). We suggest following Indiana bat guidelines (USFWS 2017): a minimum of four detector nights per 50 ha of suitable summer habitat. At FRST, this could be accomplished with eight or nine stationary points, one in each 50-ha cell, sampled for four consecutive nights, i.e., 36 detector nights. We would also recommend that a park staff member receive training in field techniques for deploying acoustic monitoring stations, bat acoustic software, manual call identification, and acoustic data management. The points should be georeferenced and permanently marked in the field for repeated sampling over time. Depending on objectives, monitoring can be done during the June-July maternity season, or even at other times of the year, such as during migration. Once started, surveys should be repeated annually to document changes in bat presence/absence or activity over time. This effort would increase the probability that WNS-impacted species historically present at FRST will be detected within suitable habitat as well as identifying those areas vital for bat conservation and management.

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Appendix A. Mist-net site descriptions and GPS locations at First State National Historical Park in July 2015.

Site	Date surveyed	GPS location	Net height	Net length (m)	Net location description
A	21 July	N39 49.525, W75 34.388	Triple	6	Across a wide, drivable path; closed canopy
A	21 July	N39 49.504, W75 34.365	Triple	12	Across a wide, drivable path; closed canopy
B	22 July	N39 49.016, W75 33.103	Triple	12	Three-way intersection of hiking trails; closed canopy
B	22 July	N39 49.025, W75 33.105	Single	6	Across a shallow, still pool in a small stream; closed canopy
C	23 July	N39 50.084, W75 34.591	Triple	9	Across a wide stream emptying into Brandywine Creek; mostly open canopy
D	23 July	N39 50.261, W75 34.369	Triple	12	Across a wide stream alongside Beaver Dam Road; mostly closed canopy
E	24 July	N39 50.509, W75 33.292	Triple	9	Across a forested hiking trail where it emerges into an agricultural clearing
E	24 July	N39 50.473, W75 33.278	Triple	12	Three-way intersection of hiking trails, open canopy directly above net

Appendix B. Acoustic site descriptions and GPS locations at First State National Historical Park in July 2015.

Site	Date surveyed	GPS location	Microphone location description
1	21 July	N39 49.700, W75 34.396	Edge of Brandywine Creek, along a wide hiking trail
2	21 July	N39 49.737, W75 33.811	Grassy clearing in a forest; near a small stream
3	21 July	N39 49.768, W75 34.080	Next to farmhouse, surrounded by agricultural fields
4	22 July	N39 49.022, W75 33.099	In closed-canopy forest
5	23 July	N39 50.066, W75 34.614	Edge of Brandywine Creek, in open grassy area
6	24 July	N39 50.523, W75 33.296	Along edge of forest and agricultural field

Appendix C. Bats captured at First State National Historical Park in 2015.

Date	Site	Species	Time	Age	Sex	Reproductive condition	Weight (g)	Forearm length (mm)	Band number	Wing score	Comments
21 July	A	EPFU	2105	A	M	TD	17	46	63200	0	
21 July	A	LABO	2135	A	F	PL	14	43	63201	0	
21 July	A	EPFU	2105	A	M	TD	15.5	44	63202	0	
21 July	A	LABO	2200								Escaped from net
21 July	A	EPFU	2110	A	F	PL	18	48	63203	0	
22 July	B	LABO	2340	A	F	PL	14	42	63204	0	
23 July	D	LABO	2109	J	M	NR	8	40	63205	0	
24 July	E	LABO	2055								Escaped from net
24 July	E	EPFU	2100	A	M	NR	13	42		0	
24 July	E	EPFU	2100	A	M	NR	15	45		0	
24 July	E	EPFU	2100	A	M	TD	15	44		0	
24 July	E	EPFU	2100	A	F	PL	16.5	46		0	
24 July	E	EPFU	2100	A	F	PL	14.5	46		1	
24 July	E	EPFU	2115	J	M	NR	11	46		0	
24 July	E	EPFU	2124	A	M	TD	15.5	47		0	
24 July	E	EPFU	2140	J	M	NR	12	45		0	
24 July	E	EPFU	2202	J	M	NR	13	43		0	
24 July	E	EPFU	2213	A	M	TD	15	46		0	
24 July	E	EPFU	2215	J	M	NR	14	46		0	
24 July	E	EPFU	2237	J	M	NR	13.5	48		0	
24 July	E	LABO	2317	A	F	PL	12	40		0	

Notes: Date, Site, and Time indicate where and when each bat was captured. Species abbreviations are as follows: EPFU = *Eptesicus fuscus* (big brown bat), LABO = *Lasiurus borealis* (eastern red bat). Age is adult (A) or juvenile (J). Reproductive condition is as follows: NR = non-reproductive, PL = post lactating, and TD = testes descended. Bands all begin with DEFW, followed by a 5 digit number. Wing score is on a scale of 0 (no damage) to 4 (highly damaged).

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